XIII. *On a Differential Barometer. By the late* William Hyde Wollaston, *M.D. F.R.S. Communicated by* Henry Warburton, *Esq. F.R.S.*

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THE instrument which I am about to describe, was originally contrived with a view to determine the force with which heated air ascends in various kinds of chimneys: but since the action of the instrument depends on its rendering extremely small differences of barometric pressure discernible and capable of measurement with considerable accuracy, it will probably be found applicable to a variety of other purposes of more extensive utility.

In many open fire-places, the slight force with which the smoke ascends, is manifest from the facility with which it is forced back by any puff of wind that the shutting of a door, or window, or other accidental circumstance may occasion: but in some, which are more judiciously or more fortunately constructed, the draft is so considerable as to require a considerable supply of air.

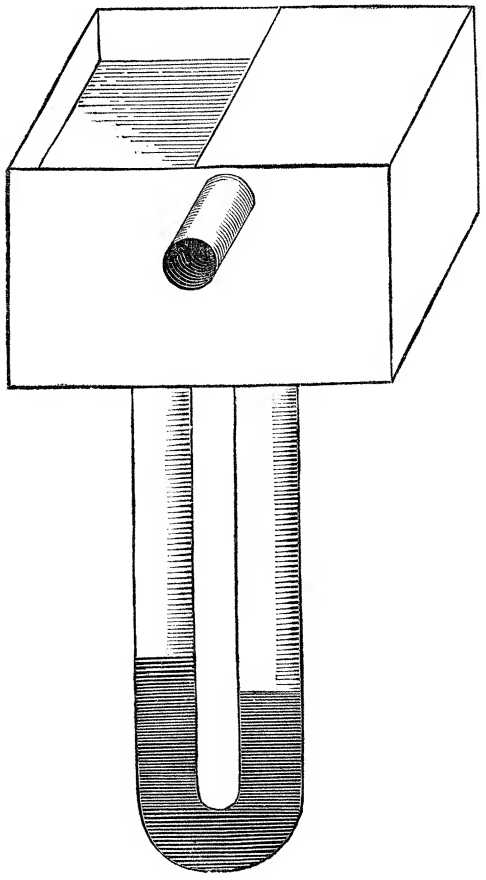
When the door or windows of a room, in which there is a fire, are open, the barometric pressure of the air is not affected by the free current of air that supplies the fire; but if the doors and the windows be all closed, then the barometric pressure within the room is lessened by the diminished weight of the heated air in the chimney; and hence the external air presses for admission at every crevice of the door or windows, with an energy proportioned to the difference of the barometric pressures within and without the chamber.

If any one were desirous of proving the existence of a difference by a mercurial barometer, the instrument employed must be of the very best construction, and all other circumstances must be very favourable to the experiment; otherwise the variation would probably be too small to be perceived, although the external pressure might be sufficient to open the door, if only closed without being fastened.

If the pressure were measured by a column of water instead of mercury, the

variations would of course be more perceptible; but the instrument, from its length, would be exceedingly incommodious. The corresponding advantage and disadvantage would be proportionally greater in employing a column of alcohol; and by having recourse to ether, we should arrive at the limit of inconvenience, as of sensibility, in any simple column.

The instrument which I have employed for this purpose is, on the contrary, very compact in its form, and the principle on which it is constructed is such, that any assignable degree of sensibility may be given to it. It consists of a tube of glass, having its internal diameter at least a quarter of an inch, bent in the middle into the form of an inverted siphon, with the legs parallel to each other. The extremities of the legs are cemented into the bottom of separate, but equal, cisterns, about two inches in diameter; one of these cisterns being closed on all sides, excepting by a small horizontal pipe opening laterally from its upper part; while the other cistern remains open.



Into a vessel so constructed, a small quantity of water is first poured, so as to occupy two or three inches of the lower part of the glass tube. Equal measures of oil are then poured into each cistern, so as to fill the upper part of both legs of the tube, and also to rise in each cistern to the depth of about half an inch.

When the two surfaces of the water in the two legs are seen to be on the same level, or have been rendered so, by equalizing the pressures of the incumbent columns of oil, the instrument is adjusted ready for use.

If the horizontal pipe from the closed cistern be now applied to the key-hole of a door or to any other perforation, through which air may enter by excess of external pressure, the pressure applied to the surface of the oil in that cistern will lower the water in the corresponding leg, and raise it in the opposite one, until the excess of the weight thus elevated is sufficient to balance the force by which the pressure of the external air exceeds that within the chamber.

It is not, however, the entire excess of the longer column of water which in this case acts as an equipoise; since that excess is counteracted by an equal elongation of the column of oil on the side depressed; so that the pressure exerted is only the difference between the column of water and an equal column of oil; which, in the case of olive oil, amounts to about $\frac{1}{11}$th part of the apparent elevation. In this case therefore the variations of this instrument are about eleven times as great as they would be, were water alone employed.

If for any other purpose an instrument of greater sensibility be required, the scale of its variations may be enlarged at pleasure, by mixing a greater or less quantity of alcohol with the water, until the excess of its specific gravity above that of oil is reduced to $\frac{1}{20}$th, $\frac{1}{30}$th, or in any other proportion; so that finally the spirit being of the strength called proof (which appears originally to have been named from this test), will rest with steadiness in no position, or being still further attenuated, will rise and suffer the oil to subside in the tube.

By a slight variation in the form of this instrument; that is by closing both the cisterns, and by applying to the upper part of each a trumpet-mouthed aperture, opening laterally; it may be made to serve the purpose of an Anemometer.

Captain Flinders informs us that on the coast of New Holland during the

prevalence of a sea-breeze, he had observed the barometer to be in general perceptibly higher than when a land-wind prevails; and he endeavours ingeniously to account for this appearance by the accumulation of air which takes place in front of any obstacle opposed to the air's motion, and which, therefore, occasions in it a greater barometric density.

It was on this principle that a species of wind-gauge was constructed by Dr. LIND, consisting of an inverted siphon, having the extremities of its two legs bent horizontally and in opposite directions. When the siphon is partially filled with water, and one of its horizontal extremities is exposed to a current of air, its pressure occasions the water on this side to descend, until its force is counteracted by the greater height of water in the opposite leg, the difference of the two columns being the measure of the force of the wind.

If a lighter fluid than water were employed in the construction of Dr. LIND's instrument, it would be rendered proportionally more sensible; but to such means of improvement there is a natural limit, since the scale could not, by means of any known fluid, be increased in a greater ratio than that of 4 to 5. Whereas by means of the instrument which is here proposed, the range of the index may be increased in any desired proportion, so as to measure the force of the gentlest flow of air.